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For corn and soybeans - Narrow Rows

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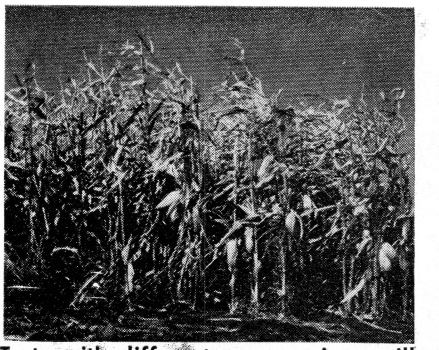
FOR CORN AND SOYBEANS,

NARROW ROWS

There's yield advantage, but costs, too, in narrow rows as compared to 40-inch rows for corn and soybeans. Since costs of changing to narrow rows will vary from farm to farm, each farmer must decide his own best time, if ever, to change.

by R. M. Shibles, W. G. Lovely and H. E. Thompson



Tests with different row spacings will continue. In last year's tests 7-inch row spacing produced the corn pictured above.

FOR YEARS, agronomists and agricultural engineers have known that 40 inches is not the most favorable row width for producing corn and soybeans. But just exactly what is the optimum row width is still open to question—despite all you might have heard or read in recent months.

Based on research at Iowa State University we can say this about narrow rows for corn and soybeans:

On the average, over a period of years, 30-inch rows will give about a 5 percent yield advantage over 40-inch rows for corn, about a 10 percent advantage for soybeans.

However, for corn in a given year, the yield advantage for 30-inch rows over 40-inch rows may vary from 10 percent to none. For soybeans, the yield advantage for narrow rows is not only greater than for corn but is more consistent.

Our research and our observations among farmers who have tried narrow rows also strongly suggest that before you go to the expense of changing row widths, you should make sure that you are first getting all the yield increase possible from adapted varieties, fertilization, weed control, insect control, timely cultural practices, and so on.

And there are costs involved in changing to narrower rows. Here, you'll have to figure your own. We know one farmer who because of his particular situation could make the switch for about $2,000. But another Iowa farmer who was adding up his costs for switching to narrow rows concluded that he would have to spend $30,000 to make the change. The big item—a change in his corn storage stystem. One study by a major equipment manufacturer indicates machine and labor costs about $2.50 per acre more for 30-inch over 40-inch spacing with 4-row equipment.

There is no easy or pat answer for the Iowa farmer who may be thinking of switching to narrow rows for corn and soybeans. In this article, we have pulled together all pertinent research and analysis on yields and costs that we think will be useful to an Iowa corn and soybean grower as he considers narrow rows.

Corn Yield Tests . . .

At Iowa State University, experiments with different row spacing for corn were conducted in the 1930's (see table 1). Then, 30-inch rows gave about 5 to 6 percent increase over 42-inch rows — very close to the increase we have been getting in recent trials comparing row widths.

Several Iowa State research workers have been investigating row crop production in various row widths. All are interested in yield differences. But engineers

TABLE 1. Acre yields of corn with various row spacings with approximately 14,000 stalks per acre final stand, 1933 to 1940, Ames. (Data from Collins and Shedd and reported in "Agricultural Engineering," Vol. 22, No. 5: 177-178, 1941.)

	Spacings between Rows	Spacings between Hills	Kernels in each hill	Yield bu. per A.	Percent increase over 42 x 42
1933-1940	21"	21"	1	68.2	14.2
	42	42	4	59.7	
1934-1940	21	21	1	64.6	12.6
	30	30	2	60.8	5.9
	42	42	4	57.4	
1937-1940	21	21	1	84.5	12.0
	30	30	2	79.8	5.8
	30	15	1	80.0	6.1
	42	10.5	1	75.7	—0.4
	42	42	4	75.4	
1938-1940	21	21	1	85.1	12.7
	30	30	2	79.4	5.2
	30	15	1	80.9	7.2
	42	21	2	77.5	2.6
	42	10.5	1	75.0	—0.7
	42	42	4	75.5	

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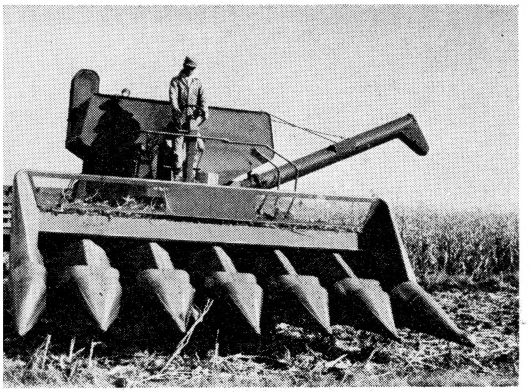

Conventional machinery is being adapted to fit narrow row requirements. Above is one manufacturer's combine with a 6-row head.

TABLE 2. Acre yields of corn planted in three row spacings at three locations. 1965. Average of all populations (hand-harvested).

Row width	Ames	Castana	Columbus Jct.
	bu.	bu.	bu.
20"	131.7	159.4	179.0
30	125.7	158.5	161.6
40	133.9	146.4	154.6

TABLE 3. Acre yields of corn at four populations. Average of all row spacings. 1965 (hand-harvested).

Population plants per acre	Ames	Columbus Jct.
	bu.	bu.
15,500	137.1	144.2
19,500	136.2	164.4
23,500	122.6	175.0
27,500	125.7	176.6

are especially concerned with equipment problems and cultural practices involved in narrow rows. Agronomists and plant breeders are particularly interested in yield and factors influencing yield such as weed control, moisture conservation and light utilization.

1965 tests by agronomists: H. E. Thompson and R. M. Shibles conducted row spacing and population experiments with a full season, high-population-tolerant, commercial, single cross hybrid at several locations in Iowa in 1965. Populations compared were 15,500, 19,500, 23,500 and 27,500. Row widths were 20, 30 and 40 inches. Fertilizer application was 200 lbs. N, 45 lbs. of P and 85 lbs. of K. Yields from different row spacings ly are shown in table 2.

Results indicate that under good moisture conditions and early planting, a moderate yield response to narrow rows can be expected. At Columbus Junction where moisture conditions were excellent, corn yields in 30 and 40-inch rows were significantly lower than in 20-inch rows. Forty-inch row corn yielded a few bushels less than 30-inch corn though the difference was not statistically significant.

In contrast, at Ames, where moisture conditions were unfavorable (3.2 inches of rain in July and August with only 0.75 inches between July 10 and August 25), none of the spacing treatments differed significantly. This was also true for tests at Sutherland and Onawa where conditions were very dry. At Castana, where moisture conditions were less favorable than at Columbus Junction but better than at Ames (Castana had a 2.6 inch rain in mid-July), 20 and 30-inch rows outyielded 40-inch rows.

The populations giving maximum yield depended again upon the moisture conditions. Under the favorable conditions at Columbus Junction, yield increased with population up to 23,500 plants per acre (table 3). Under the very dry conditions at Ames, yields at 15,500 and 19,500 plants per acre were the same but dropped at higher populations. The other dry locations — Sutherland and Onawa — showed no yield depression at the higher populations; all populations there yielded about 120 to 125 bushels per acre.

Other effects: In mid-October, a high wind caused heavy stalk lodging at most locations. Generally, stalk lodging was not affected by row width but increased with population. At Sutherland, Castana and Ames, lodging increased by 15, 27 and 31 percent as population

TABLE 4. Acre yields of corn grown in 30 and 40-inch rows and different plant populations, Ankeny, Iowa. 1963-65.*

Stand (plants per acre)	1963			1964						1965		
	40"	30"	% increase	40"	30" (early planting)	% increase	40"	30" (late planting)	% increase	40"	30"	% increase
	bu.			bu.			bu.			bu.		
10,000	104	109	4.8%									
13,000	114	118	3.5									
15,000	123	131	6.5									
18,000	127	134	5.5									
19,000				105	111	5.7%						
20,000							102	105	2.9%	105	105	..
21,000				105	114	8.6						
22,000	127	135	6.3				91	104	14.3			
24,000										98	101	3.1%
25,000				106	113	6.6						
27,000							81	94	16.0	89	94	5.6
28,000				104	110	5.8	78	92	17.9			

* The assistance and cooperation of Ankeny Farm Service and the Deere and Co., Des Moines Works, in conducting these studies is acknowledged.

increased from 15,500 to 23,500 plants per acre. At Onawa, a severe early drouth reduced plant height about 25 percent and lodging was low—only 4 to 5 percent. At Columbus Junction, lodging was not different between populations, but hail caused a fairly uniform 14 percent lodging.

Few barren stalks were noted in the higher plant populations because a good, population-tolerant hybrid was used in the tests.

General Conclusion: Where conditions were favorable, 30-inch rows produced about 6.5 percent more corn than did 40-inch rows. Under unfavorable dry conditions, no significant reduction in yield was caused by narrow row planting.

1963-65 tests at Ankeny: W. G. Lovely conducted a series of narrow row corn experiments at the Experiment Station Research Farm at Ankeny, Iowa, in cooperation with the Agricultural Research Service, USDA. These studies were aimed at evaluating equipment needs and cultural practices for 30 and 40-inch corn rows at different plant populations.

Full season commercial hybrids were planted with 200 lbs. N, 32 lbs. P and 30 lbs. K as the fertilizer application. These were "field scale" experiments where 4-row and 6-row equipment were used for planting, cultivating, spraying and harvesting.

Results indicated that most of the planting, cultivating and harvesting equipment available for 40-inch rows could be adapted easily to 30-inch rows.

Yield results from these tests are shown in table 4. In 1963, 30-inch rows averaged 5.3 percent yield increase over all stand levels. Two plantings—one in early May and one the middle of May—were made in 1964. For the early planting, stands of 19,000, 21,000, 25,000 and 28,000 stalks per acre in 30-inch rows gave yield increases from 5.7 to 8.6 percent. Highest increase came at 21,000 population.

Plant populations of 20,000, 22,000, 27,000 and 28,000 were used in the later planting. Yield increases ranged from 17.9 to 2.9 percent with the largest increase at the 28,000 stand. However, the stress caused by high population and late planting resulted in yields less than 100 bushels per acre.

In 1965, stands of 20,000, 24,000 and 27,000 stalks per acre were used. At the 20,000 population, yields from 30 and 40-inch rows were the same. At 24,000 plants, 30-inch rows gave a 3.1 percent increase; at 27,000 population, a 5.6 percent increase.

In the 16 comparisons of 30-inch with 40-inch rows at Ankeny, higher yields were obtained with 30-inch rows in all except one comparison. However, percentage increase was not large, particularly at the 15,000 to 20,000 populations.

In other studies, corn was planted with a grain drill in 7, 14, 21 and 28-inch rows and harvested with a modified small grain platform. Herbicide applications were used to control weeds. Results were promising enough to indicate that rows as such may be eliminated in corn and soybean production if varieties, equipment and production techniques can be developed.

Soybeans in Narrow Rows . . .

Compared with corn, soybeans in narrow rows respond to a greater degree and more consistently. In 1965, agronomist I. C. Anderson of Iowa State tested several soybean varieties in 28 and 42-inch rows and under irrigation and non-irrigation. Planting rate was 150,000 seeds per acre for 42-inch rows and 190,000 seeds per acre for 28-inch rows.

All varieties tested increased in yield in the narrower rows (table 5). Under irrigation, average yield increase was 16 percent. The non-irrigated plot received only 3.18 inches of rain from July 1 to August 30. Despite this drouth stress, the average increase in yield for the narrow row plantings was 21 percent.

Soybeans will respond to planting in even narrower rows. In 1961 and 1962, C. R. Weber, R. M. Shibles and D. E. Byth tested Hawkeye soybeans at 100,000 plants per acre in 10, 20 and 40-inch rows (table 6).

Yields increased from 12 to 35 percent as rows were narrowed from 40 to 20 and 10 inches, respectively. The reasons for the yield response were (1) more interception of sunlight (earlier fill-in) and (2) a higher percent of dry matter conversion to beans in narrow rows. The solid-drilled (10-inch row) beans intercepted 10 percent more sunlight during the season than 40-inch rows and, therefore, produced more dry matter.

In addition 25 percent of the dry matter was converted to beans in solid-drilled beans; only 21 percent was converted to beans in 40-inch rows. These results indicate that where weed-free condi-

TABLE 5. Acre yields of soybean varieties at two row spacings. Ames, Iowa, 1965 (Hand-harvested).

	Not irrigated			Irrigated		
	Row width		Percent increase	Row width		Percent increase
	42"	28"		42"	28"	
	bu.			bu.		
Amsoy	27.2	31.6	16	44.7	54.3	21
Harosoy	24.7	30.5	23	41.7	48.5	16
Wayne	23.3	28.0	20	47.1	51.7	10
Ford	21.5	26.1	21	41.3	49.7	20
Clark	21.1	25.9	23	42.9	49.2	15
Ave.	23.5	28.4	21	43.5	50.6	16

TABLE 6. Acre yields of Hawkeye soybeans at several row width. Ames, Iowa. Average of 1961 and 1962 yields (Hand-harvested).

Row width	Yield	Percent increase over 40" row
	bu.	
10"	47.9	35
20	40.1	13
40	35.4	. .

tions can be maintained, solid-drilled beans with 6-inch to 8-inch shoe spacing should be considered.

Conclusion: Soybeans consistently respond to reduced row width. Soybeans yield highest when solid-drilled, *provided weeds are controlled.* If beans must be cultivated, rows should be as narrow as equipment will handle.

Narrow Rows More Efficient . . .

Shaw and Yao, in experiments at Ames, have shown that there are several reasons why narrow row spacing has an advantage over wider spacing at the same plant population. Table 7 shows some of these reasons.

Highest yields were attained at the high plant population and at the 21-inch spacing. At the same plant population, less water was lost from the field at the narrow row spacing. The reason for the lower water loss in narrow spacing is that the plants catch a higher percentage of available light. Therefore, less light gets through to the soil surface, and less water is lost by evaporation from the soil surface. At the same time, the greater interception of light by the corn plants results in more photosynthesis and dry matter production. Also, when less light gets through the plant canopy, late weeds are not as serious a problem because there is less light available for their growth and development.

The main reasons for the advantage for narrow spacing are the more efficient use of light, moisture and nutrients.

Equipment . . .

European and South American corn producers have used 28-inch row spacing for many years. So there is nothing magic about 30-inch row spacing. But tractors, planters, cultivators, sprayers and harvesters that are now being manufactured and sold to Iowa farmers can be adjusted to fit the 30-inch spacing. It is impossible to use a tractor with a 22-inch tire tread in 20-inch row, but this size tire can be used in 30-inch rows. Although some are being manufactured, picker heads for 20-inch rows are more difficult to produce than picker heads for 30-inch rows.

Unless you are willing to have two sets of equipment, don't try to have two row spacings. We have tried this and found that our wheel and equipment spacings were usually wrong when we needed them most.

Before you decide to go to narrower rows, be sure to consider all of your field operations, not just planting and harvesting. Sprayers, for example, usually have nozzle openings every 20 inches along the boom, and this arrangement will not work for row applications on 30-inch rows.

Wheel spacing for pull-type and self-propelled sprayers is usually adequate for 30-inch rows, but this should be carefully checked. Remember that the center of the wheels will be only 5 inches from the row center on 30-inch rows with a wheel spacing of 80 inches.

TABLE 7. Effect of row spacing and corn plant population on yield, moisture loss from field, use of light and water. Ames, 1960* (hand-harvested).

	Row spacing					
	21 inches		32 inches		42 inches	
Population plants per acre	14,000	28,000	14,000	28,000	14,000	28,000
Yield bu. per acre	132	153	123	148	122	144
Inches of water lost from field	13.2	15.0	15.5	16.6	15.8	17.1
Ratio: radiation at ground level to that above plants	.25	.16	..	.20	.31	.23
Efficiency of water use bu. per inch	10.0	10.2	8.0	8.9	7.7	8.4

* under irrigation.

Summing Up . . .

Each corn and soybean grower will have to decide for himself when, if ever, it is to his advantage to shift from conventional 40-inch rows to narrower rows. Following are some factors that should be considered in a decision on shifting to narrow rows.

1. Your acreage in corn and soybeans. You can expect about a 5 percent increase in corn yields and a 10 percent increase in soybean yields from 30-inch rows. Will this pay for making the shift?

2. Present yields. You should have a 100-bushel average (except for drouth years) for your farm and occasionally 125 bushels per acre.

3. Fertility program. Are you making optimum use of fertilizer now? If not, do this at your present row spacing and you'll probably get considerably more than a 5 percent increase in corn yields. A good fertility program is essential to obtaining yield response from narrow rows.

4. Insect and weed control. Are you doing the best job that can be done now?

5. Hybrids and plant population. Are you selecting the best hybrids available and planting them at their optimum population level? If not, concentrate on these. Doing a better job in selecting hybrids and planting them at their optimum population could mean a 10 to 30 percent increase in yield at your present row spacing. For best combining results, consider hybrids with dense cobs.

6. Management. Do you get things done on time—like finishing planting by May 10, hoeing and cultivating on time, harvesting when corn is ready to reduce harvest losses, etc.?

If each of the six items listed above can be answered positively, then you should seriously consider shifting to narrow rows. But if you are to take advantage of the potential yield response of narrower rows, *you will need a high level of management,* that is, do everything right. And you should calculate carefully all costs and all advantages of converting to narrow rows as they apply *on your particular farm.*